Chapter 6

Patient Care and Comfort

Unique conditions are found when transporting patients by air. Several factors make air medical transportation different from ground transportation. The U.S. Air Force (USAF) has identified some of these factors as "stresses of flight." They directly influence the patient and the medical escort and are inherent in flying. This chapter summarizes the stresses of flight, the effects of medications, general care needed throughout an air medical flight, and specific interventions needed at higher altitudes.

Learning Objectives

Upon completion of this chapter, the participant should be able to:

- List six stresses of flight.
- Describe six measures air medical escorts can take to reduce the effects of the stresses of flight.
- List two examples of patient conditions that benefit from special positioning in an aircraft.
- List six factors unique to providing patient care in the airborne environment.
- List three methods of preventing the progression of motion sickness.

Stresses of Flight

In its publication, *United States Air Force Flight Surgeons Guide*, the United States Air Force (USAF) lists eight common stresses of flight: decreased partial pressure of oxygen; barometric pressure; noise; vibration; gravitational forces (G-forces); thermal changes; decreased humidity; and fatigue. *The Air Medical Crew, National Standard Curriculum Student Manual* also lists "third spacing" as an additional stress. The significance of each of these stresses is explained below.

Decreased Partial Pressure of Oxygen

Decreased partial pressure of oxygen can result in hypoxia; it has been discussed in Chapters 3 and 4.

Barometric Pressure

The effects of changes in barometric pressure have been discussed in Chapter 5. These include barotitis (inflammation of the ear due to sudden pressure changes), abdominal gas pain, barosinusitis (pain and/or inflammation of the sinus due to changing altitudes), and barodontalgia (tooth pain from changing atmospheric pressure).

Noise

Aircraft engines and helicopter rotor blades produce high noise levels during operation. This noise makes it difficult to communicate with patients and other members of the flight crew.

It also makes auscultation difficult or impossible.

Internal cabin noise interferes with the use of stethoscopes and can mask the sound of air escaping from tubes or faulty respirators. Air medical escorts should be comfortable palpating blood pressures and should frequently inspect all equipment being used on their patients. These high noise levels are one reason why it is important to examine patients carefully before placing them in aircraft.

In addition to causing hearing loss, noise can increase fatigue. Ear protection for neonates is mandatory and may include covering the ears directly with things like sponge earplugs or cotton balls taped over

the ears. Stocking caps can hold the ear protection in place. Placing blankets or covers over the isolette may also help to muffle sounds.

Escorts should carry ear protection items (e.g., ear plugs, headsets, etc.) for all patients and offer them when appropriate. Simple sponge-type ear protectors (ear plugs) usually will decrease the noise level enough to protect against hearing loss. The Noise Reduction Rate (NRR), in decibels, is usually reported by the earplug manufacturer.

Vibration

Vibration from the engine/s and air turbulence is a significant factor during air medical flights. Vibration can:

- Worsen pre-existing middle or inner ear disease, making patients with these problems more susceptible to motion sickness.
- Cause headaches, shortness of breath, chest pain and abdominal pain.
- Worsen overall fatigue.

Vibration can increase the pain from a fracture. The following steps can help minimize the effects of vibration on the patient's comfort:

- Properly immobilize fractures before the flight.
- Strongly consider giving analgesics.
- Use a consistent pressure device (e.g., Collins' springs) or a fixed device (e.g., Hare or Sager type splints) when traction must be used in flight. Free hanging traction weights are not appropriate in flight due to turbulence and changes in acceleration.
- A Kendrick's Extrication Device (KED) may be used to stabilize a fractured hip. The torso section of the KED is placed around the patient's waist and the head immobilization section is wrapped around the affected leg. This immobilizes the hip and leg for transport. Empty spaces should be packed with towels or cloth.

Vibration often interferes with the proper functioning of electronic devices such as infusion pumps. Equipment should be tested for use in the aviation environment before it is used on patients.

According to the US Army School of Aviation Medicine, overweight crewmembers and patients are more susceptible to the physiological effects of vibration. The effects of vibration can be reduced by:

- Properly securing patients.
- Assisting patients with position changes.
- Providing adequate padding to patients.
- Ensuring that vibration does not cause blankets or other materials to rub against the patient's skin.

Gravitational (G) Forces

Changes in aircraft speed and direction impose gravitational forces (G-forces) on the body. Take-off acceleration and the deceleration of landing exert forces that run along the line from the nose to the tail of the aircraft (linear forces). Sharp, high speed turns and elevation changes create G-forces in other directions, both lateral (side-to-side) and vertical (up-and-down). Normally, vertical and lateral forces are not critical in commercial aviation or on air medical transports. Linear forces have the greatest effect on patients. Generally, acceleration on take-off is the strongest force, the faster the rate of acceleration, the more severe the effects.

The principle of inertia states that a mass at rest tends to remain at rest (or resist movement) and that a mass in motion is inclined to stay in motion. In the body, relatively rigid muscular and skeletal structures move with the aircraft, while softer tissues such as the diaphragm, abdominal organs, and blood, respond to inertia.

When an aircraft accelerates down a runway, solid structures move easily with it, while softer organs tend to remain at rest. Deceleration affects organs in the opposite way. Rigid organs slow with the aircraft and soft tissue continues to move toward the front of the plane.

Figures 6–1 and 6–2 illustrate the effects that patient positioning has on blood movement during take-off and landing. Blood movement corresponds to regional changes in blood pressure, and can lead to

problems for the patient. All blood at a particular (horizontal) level forms a "column" of pressure during acceleration, and applies that pressure at the far end of that "column." In the supine patient placed with head toward the tail of the aircraft, for instance, a "column" consisting of almost the entire blood volume concentrates pressure on the brain during take-off.

The brain is sensitive to these pressure changes. Its location inside the skull leaves it little room to adapt to increasing pressure. Brain matter is very soft. It reacts to forces of inertia by being pushed against the skull.

Elevation of the head and shoulders helps reduce the effects of acceleration and deceleration by reducing the size of the "blood column" putting pressure on the brain. FAA regulations for stretcher systems must be considered before elevating the head of the bed on take-offs and landings (e.g., some systems require the patient to be flat on take-off and landing).

Some air medical services load their patients in the same direction/position for every flight. This may be based on the particular requirements of the aircraft or on the experience and direction of their physician medical director. Other air medical services change the direction/position of their patients based on the patient's presenting condition and the potential effects of G-forces. Each of the patient's diagnoses should be considered separately if an organization bases a patient's position on his or her medical condition.

- Patients with head injuries and increased intracranial pressure (ICP) generally should be placed with their heads forward.
- Patients who are in their last trimester of pregnancy or who are in labor may benefit from being positioned in the aircraft with their heads aft.

It is important to know if alternate positioning of a stretcher is approved by the FAA for each aircraft used for air medical flights.

Pilots also can help to minimize the effects of G-forces on patients by:

- Bringing the aircraft down more slowly (taking a shallower descent).
- Increasing the distance accelerating and decelerating on landing and take-off (longer rollouts).

Figure 6–1: The Effect of Elevating the Head on the Size of the Blood Column

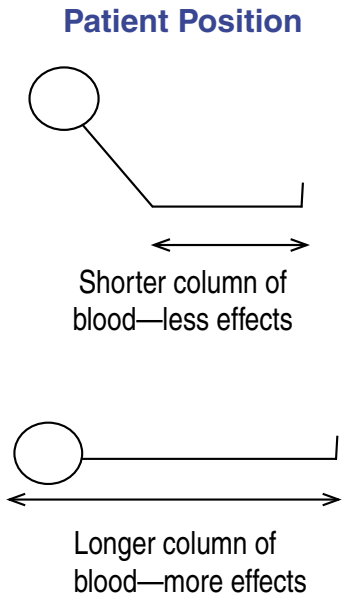
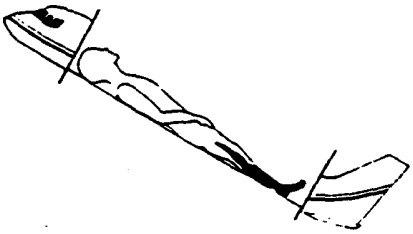
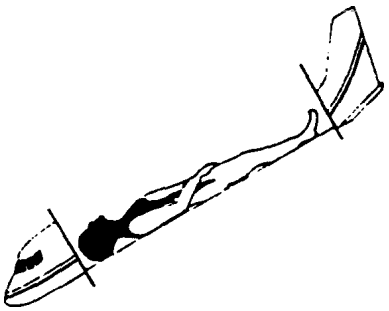


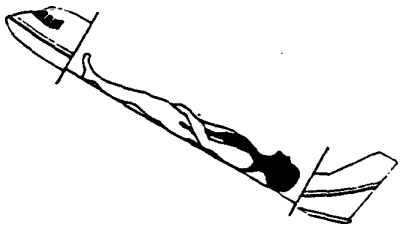
Figure 6–2: G-Forces and Positioning on the Litter Patient
Dark areas indicate where G-Forces are concentrated.



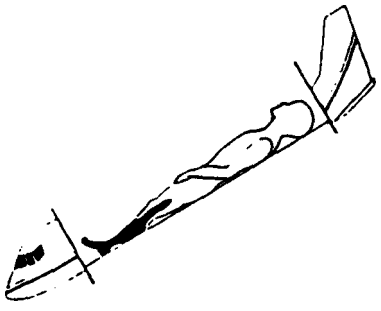
During Take-Off (Acceleration)



During Landing (Deceleration)



During Take-Off (Acceleration)



During Landing (Deceleration)

Pilots usually have greater flexibility in reducing G-forces during landing than on take-off. If air medical escorts would like pilots' assistance in reducing G-forces, they should communicate this early to help the pilot in planning the flight. Other factors that influence the pilot's ability to assist in reducing G-forces include the:

- Type of aircraft being used.
- Length of the runway or landing zone.
- Current conditions of the runway or landing zone.

Decreased Humidity

Humidity decreases as altitude increases. Heating and pressurizing air also lowers the humidity in aircraft. The resulting dry air can worsen medical conditions and make the patient feel uncomfortable.

Some solutions to combat decreased humidity during flight include:

- Using humidified oxygen to prevent thickening of secretions.
- Using devices that scavenge intubated patients' exhaled moisture.
- Applying drops or ointment, or taping patients' eyelids if they are unconscious, to prevent drying of their corneas.
- Permitting patients to drink fluids if their medical condition permits. Drinking water is generally preferable to drinking coffee or carbonated beverages.
- Some patients may be restricted from drinking fluids. The air medical escort may check to see if the patient may have a limited number of ice chips. Sometimes a moist washcloth or moistening the mouth with a lemon glycerin swab is permitted.
- Other patients, including those requiring urgent surgery may be NPO, which means give nothing by mouth. Air medical escorts MUST consult with a physician responsible for the patient before permitting patients who are NPO to have anything by mouth.

- Provide mouth care at least every two hours to comatose, paralyzed or otherwise helpless patients. Cleaning their mouths with moistened sponges or washcloths can be beneficial.

Temperature Considerations

Ambient temperature decreases as altitude increases. Heating systems in aircraft used for air medical transports may have hot spots and cold areas. The inside shell of the aircraft ("the outer wall") is usually cold. Hypothermia can worsen many medical problems or can cause coagulopathies (clotting problems). The following steps can reduce the risk of hypothermia:

- Placing a blanket or other barrier between the wall and the patient to insulate them. This reduces the conduction of heat from the patient's body to the wall.

- Having adequate blankets and/or patient packaging materials (e.g. Dr. Down®, stocking cap, etc.) to help patients stay warm enough.

- Wrapping patients so their blankets open along their anterior midline. This allows escorts to access patients for treatments and observations while minimizing their loss of heat from removal of insulation.

- Using foam egg-crate mattresses, which are used in hospitals, as insulation for stretchers and to line the inside of Stokes baskets.

Both air medical escorts and patients should be prepared for unheated ground delays in the event of mechanical trouble, forced landing, or sudden weather changes.

Fatigue

Fatigue is the end product of each of the physiological and psychological stresses associated with flight.

A period of rest, especially on a long flight, helps the patient's mental outlook. Rest may also help the patient to feel better when they arrive at their destination. Earplugs, dimmed cabin lighting, and helping the patient find a comfortable position may help the patient sleep.

Third Spacing

Third spacing is the loss of fluids from the intravascular space into the tissues. It is caused by increased intravascular pressure and increased permeability of the cell walls at higher altitudes. This phenomenon can be caused by temperature changes, vibration, and G-forces, all of which can cause vasodilation and vasoconstriction. These then can lead to leaking of fluid. Third spacing occurs most often during high altitude or long-distance flights. The signs and symptoms of third spacing include:

- Increased heart rate.
- Edema.
- Dehydration.
- Decreased blood pressure.

Providing Patient Care in the Airborne Environment

In addition to the "stresses of flight," special circumstances found in the airborne environment make patient care different from patient care during ground transport and at clinics and hospitals. Seven factors that can affect patient care will be explained in this section of the chapter: patient positioning, poor lighting, motion sickness, turbulence, prolonged immobility, elimination and limited space.

Patient Positioning

Proper patient placement helps provide efficient in-flight care, safe loading and unloading, and makes the patient more comfortable. Factors that affect how the patient can be positioned within the aircraft include G-forces (which were discussed earlier) and the physical layout of the aircraft (e.g. number of seats, fixed as opposed to adjustable litter supports, etc.).

While patient, family and physician requests are important; the final responsibility for safe patient positioning is the responsibility of the medical escort and the Pilot-In-Command. When there is more than

one option for placement of a patient, air medical escorts should consider the following in deciding where to put patients:

- The patient's medical diagnosis.
- The patient's size/weight.
- The patient's preferences.
- The treatment required en route.
- Scheduled stops.
- Possible aircraft emergencies.
- The conditions at the destination.

When transporting patients on commercial airlines the following suggestions can be helpful:

- Seat patients away from emergency exits. They could block the rapid exit of others. This is especially important with psychiatric patients, children, the elderly and those with extremity disabilities.
- Place patients who are prone to seizures away from windows to minimize the chances of flicker-induced seizures.
- Seat patients with upper extremity fractures next to an unoccupied seat. This empty seat should be on the same side as the injury. This allows the patient to elevate the cast.
- Choose bulkhead seats. They provide a little more room, which can be useful for equipment or to perform CPR.
- Fold the seat back in front of a patient with a short leg cast or lower extremity circulatory problem when elevation is desirable.
- Position patients with visual handicaps and those with gastrointestinal disorders near a restroom.
- Stow and secure medical equipment properly.
- The Pilot-in-Command has the final say on where the patient will be placed on the aircraft.

Lighting

Often, aircraft lighting is inadequate. It is difficult to detect subtle changes in patient condition in a poorly lit aircraft. A flashlight or headlamp can be a useful adjunct to onboard aircraft lighting.

- Lights that can be secured to the aircraft or on escorts' clothes or heads are more effective than holding flashlights while trying to perform patient care.
- Flashlights should NEVER be held in an air medical escort's mouth due to concerns about infectious disease.
- Escorts should discuss the use of flashlights with pilots before a flight if the patient care area and the flight deck are not separated.

Sunlight coming in the window can cause discomfort for the patient. Sunlight can also interfere with the function of medical equipment, (e.g. pulse oximeter probe) or the ability to read monitors. If there are no window darkening features built into the aircraft, attaching automotive-style window shades to the aircraft windows may make the patient more comfortable.

Motion Sickness

Preflight assessment of patients should include assessing for the potential for nausea and vomiting. Patients with the following conditions are at high risk for vomiting:

- Serious illness or injury.
- Shock.
- Head injuries.
- Abdominal injuries.
- Intestinal obstruction or decreased motility.
- Anyone who has ingested irritating substances.

Air medical escorts also must be alert to patients who are at increased risk of aspiration if they vomit. Conditions that increase aspiration risk include:

- Decreased level of consciousness.
- Alcohol intake.
- Drug overdose.

In these situations escorts should consider intubating patients to protect their airways, and/or placing nasogastric tubes (NG tubes) before transfer. NG tubes allow escorts to suction air and stomach contents en route with suction machines, manual suction devices or large syringes. This can decrease nausea and vomiting.

In a study of motion sickness in a medical rotor-wing service, 7% of the patients complained of nausea during or immediately after the flight, with 1% of the study patients actually vomiting.[1]

Some studies have found a five times higher incidence of motion sickness in women than in men, but these studies generally relied on questionnaires or past history. In a study performed by Jokerst et al, women reported symptoms of motion sickness more frequently to examiners, but both men and women had similar measurable gastric reactivity to stimulus.

Another study showed that "infants below the age of two seldom experience motion sickness, but susceptibility increases from two to about twelve years of age. Susceptibility then declines slowly for both males and females."[2] A third study reported that "infants below the age of two are generally immune to motion sickness, susceptibility is greatest between two and twelve, and motion sickness is rare beyond the age of 50."[3]

Environmental sources also can contribute to the development of motion sickness. If the aircraft is too warm and/or there are strong odors in it, people are more likely to become airsick. Their symptoms often subside a few minutes after the temperature drops and/or the odor disappears.

Assuming that the cause cannot be avoided, the following steps may slow symptom progression:

- Administer oxygen by mask.

[1]T. T. Levins, "Air Sickness in Flight: Frequency and Factors," *Air Medical Journal* 22.1, Jan.–Feb. 2003, pp. 26–27.

[2]R. M. Stern and K. L. Koch, *Motion Sickness and Differential Susceptibility,* American Psychological Society, Cambridge U P, Cambridge, 1996.

[3]R. M. Stern, "Acta Biologica Hungarica," *The Psychophysiology of Nausea,* 53.4 2002, pp. 589–599.

- Have patients lie down and stay still.
- Place a cool cloth on patients' foreheads or behind their necks.
- Suggest that the patient look at a stationary object.
- Cool the cabin slightly. A cool (not cold) aircraft cabin is one of the best methods of preventing nausea in patients. Generally, pilots can turn down the heat on request. Patients should not be permitted to become cold.
- Consider stomach decompression with a NG tube connected to suction.
- Administer preflight medications (anti-emetics) like Compazine®, Phenergan®, Inapsine®, and Tigan®.

Patients who are likely to vomit can be placed on their sides for transport. They must be securely strapped in this position. Their backs should be padded with a rolled blanket for comfort.

If vomiting is a possibility, a bucket, a commercially available emesis collection device (e.g. Convenience Bag® or Bio-hoop®), or a plastic trash bag needs to be out and ready. If the patient vomits on the litter or floor of the aircraft, the odor lingers, causing further nausea or vomiting. Plastic garbage bags:

- Are inexpensive, readily available, and require little storage space.
- Are easy for a patient to vomit into without making a mess.
- Can be tied closed so the odor is less likely to permeate the aircraft.
- The escort can make a hole near the top of a large garbage bag and slip the bag over the patient's head. It will look like a bib, but the entire bag is open on the patient's chest. The picture at left illustrates this.

Model: Sierra Risley.

Turbulence

Turbulence can cause or worsen motion sickness in patients.

Turbulence can cause sudden movements in the aircraft. The movement can dislodge endotracheal tubes or chest tubes if they are not adequately secured. Tubes should be:

- Secured immediately after insertion.
- Checked frequently for correct placement during flight, especially whenever patients are moved and after turbulence.

Turbulence can cause a worsening of pain in patients with orthopedic injuries. This can be minimized by:

- Careful splinting of fractures and dislocations.
- Using additional padding when splinting a patient with a fracture.

Turbulence can cause unsecured equipment to fall, which may damage the equipment, or more importantly, cause injury to patients or escorts. All equipment and personnel should be secured for the entire flight as a safety measure.

Air medical escorts may need to remove their seat belts for a few moments during flight to provide patient care. Seatbelts should be refastened as soon as possible. After take-off, the straps securing the patient to the litter can be loosened slightly for patient comfort. But these straps should be re-tightened if turbulence is encountered and for landing.

Prolonged Immobility

Patients who require transportation by air usually have limited opportunities for movement. This is especially true when they are secured to a stretcher or backboard or are in a Stokes basket. Immobility can causes stiffness and pain for patients.

Several basic interventions can help improve patients' comfort:

- Ask the patient about their comfort or pain levels. Look for non-verbal cues as well as listening to their response.
- If their medical condition allows, patients may want to sit up during flight. Movement reduces fatigue and helps prevent venous stasis. Some transport litter systems are designed to elevate people's heads. Otherwise, the patient's head and shoulders can be elevated with pillows, blankets, or other materials at hand.
- Limbs must be supported when they are maintained in special positions (e.g. to maintain a positional IV or have easy access for administering IV medications).
- Body areas that arch away from the litter, like the lumbar area and behind the knees, can be padded.
- Reading, listening to music, or chatting with the air medical crew may help distract the patient from the flight or their discomfort.
- Exercising in place can reduce body tension and fatigue when a full position change is not practical. Moving joints through their normal arc and doing isomeric exercises like squeezing a small rubber ball or pressing a limb against the litter can relax the body, divert the mind and stimulate circulation. The nature of the chief complaint may limit activity, however.

Elimination

A "comfort kit" consisting of a bedpan, urinal and airtight containers for odorless storage (e.g. plastic trash bags) is a must for in-flight care. Unconscious or critical patients may require a Foley catheter and/or diapers.

There are products (e.g. SafeSorb®) that can be added to containers to solidify urine or other liquids in the aircraft. These work well for disposing of urine if there is no bathroom on board the aircraft. Any body fluids or other potentially infectious materials from patients should be transported to the receiving facility and disposed of appropriately; once urine is solidified, it is easily transported in plastic bags. These products are available through pilot supply shops, some EMS vendors, and some hospitals.

If escorts suspect that their patient may be incontinent during a flight, they may want to prepare the stretcher with extra towels and absorbent pads or place a diaper on the patient. If the patient is incontinent during flight, the wet layers can be removed more easily than changing the wet sheets entirely. Most hospitals have adult-size diapers for incontinent patients. If time allows, it may be best to place one on the patient prior to flight.

Limited Space

With the exception of the larger critical-care air ambulances, the majority of transport aircraft have a small patient care area. Even if the volume of the aircraft is large by aircraft standards, the shape may not be optimal for patient care.

The Lear 31A has a total volume of 271 cubic feet (www.bombardier.com/en/3_0/3_2/pdf/Learjet_31A_Fact_Sheet_en.pdf, p. 2), while the 2003 Chevrolet Van Express with standard wheelbase has 276 cubic feet (www.chevrolet.com/express/index.html). Both vehicles have a cabin height of 4.3 feet, but the cylindrical shape of the Learjet makes it difficult for air medical escorts to get their shoulders above their patients' chests to perform chest compressions.

In some of the smaller helicopters (e.g. Bell 206 and the American Eurocopter A-star) the patient's legs pass into the flight deck.

The confined space in most aircraft is a compelling reason to stabilize patients before transport. Patients will be more comfortable, and have a safer flight if the air medical crew secures their airways, controls bleeding, splints fractures well, and works to stabilize their vital signs before the flight.

Whole Person Care

Just providing good technical medical skills falls short of the fullest meaning of "health care." The medical escorts must try to address the emotional needs of their patients as well as providing the correct medications and procedures.

Besides the physical stresses of air transport, patients usually experience a variety of emotional stresses. These may include feelings about:

- Separation from their families.
- Disruption of their work or school schedule.
- Other disruptions in their personal life.

Intervention to minimize emotional strain will help to decrease fear, fatigue and, possibly, medical deterioration due to stress.

Although most people in Alaska have flown in large, commercial airliners and small bush planes, most have not flown while under the stress of a medical emergency. If patients are conscious, it is vital that air medical escorts relay as much information to them as possible. Escorts should communicate an air of confidence and provide detailed descriptions of the transfer procedure and what patients can expect. They also should be clear in requesting that patients give them any relevant or important information for the flight.

The following suggestions can help air medical escorts in addressing patients' emotional needs:

- Talk to patients. This may sound simple, but the details of a medevac can distract escorts from establishing and maintaining rapport with their patients. Personal contact leads to confidence in the escort and can reduce fear.
- Brief the patient thoroughly about what to expect from the flight. Informed patients are more likely to be relaxed. Patients like to know the remaining flight time; what will happen next (regarding both medical and transport arrangements), what family members are doing and the reasons for the activities performed during a flight.

- Organize ground and air transport completely before moving patients. Delays are tiring and frustrating for patients. They are usually not feeling well, and generally want the flight to be finished. Patients should be made aware of the plan, and be a partner in completing it.

Summary

There are many stresses from flying. A well-trained air medical escort can lessen the effects of many of these stresses. Learning about the causes of these stresses, the impacts on the human body, and training in techniques to lessen the effects provides air medical escorts with tools to deliver the highest quality transport and care.

Notes